

IMAGE PROCESSOR LIST FORMATS

1. SCOPE

IP lists are used to extract and/or group sets of pixels together. There are 5 specific type of list driven capabilities in the IP. A different instruction realizes each type. Each of these instruction is driven by a list which has a specific format. This document defines the format of the lists and defines the DEP capabilities to create and load them.

2. GENERAL FORMAT

All lists have the same general format, which is a 16 word header followed by some number of entries. Several of the lists contain entries that point to other lists. A list must be filled with 1's from the end to the actual data in the list to an address that is the next integer multiple of 4 plus 4, i.e. at least 4 and as many as 7 additional addresses.

3. HEADER

All list header are of the format shown in figure 1. The ID is a code that matched the instruction code that uses the list. All parameters in the header are supplied by the DEP either automatically or from information supplied in the telecommand(s) that created the table. See DEP section for details on header creation.

WORD	CONTENTS	DESCRIPTION
0	ID	CREATED BY DEP OR INCLUDED IN TELECOMMAND
1	VERSION NUMBER	SUPPLIED IN TELECOMMAND
2	NUMBER OF ENTRIES	CREATED BY DEP OR INCLUDED IN TELECOMMAND
3	ROW LENGTH	LENGTH OF SOURCE ROWS
4-6	LOBT	TIME LOADED. SUPPLIED BY DEP
7-15	OPTIONAL DATA	IF PRESENT, SUPPLIED IN TELECOMMAND

Figure 1 IP List Header

4. CROPPING LIST

A Cropping List is a simple list in which each entry contains an address and a length. Each address is an offset from the source address supplied to the crop instruction. Figure 2 shows a cropping list entry.

WORD	CONTENTS
0	LOW ORDER ADDRESS
1	HIGH ORDER ADDRESS
2	LENGTH (WORDS)

Figure 2 Cropping List Entry

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5. VECTOR BIN LIST

A Vector Bin List contains entries that reference 2 vector lists and an address list. Address and vector lists do not contain headers. The IP instruction multiplies the 2 vectors to produce a rectangular array of weights. Each address in the address list contains the upper left pixel of a rectangle. Pixel addresses in the address list are low address word first. The IP instruction multiplies each pixel in the rectangle by the equivalently positioned weight and adds the result to a running total. Each address in the address list produces one number which is scaled using the shift count. Each Vector list entry produces NBINS results sequentially stored at the instruction's destination address. See the section on IP instructions for further processing details. Figure 3 shows a Vector Bin List entry.

WOR	CONTENTS	DESCRIPTION
0	NBINS	NUMBER OF ADDRESSES IN THE ADDRESS LIST
1	NX	SIZE OF THE XVECTOR
2	NY	SIZE OF THE YVECTOR
3	SHIFT	SHIFT COUNT FOR SCALING
4-5	ADDRESS LIST	LOW ADDRESS FOLLOWED BY HIGH
6-7	XVECTOR	LOW ADDRESS FOLLOWED BY HIGH
8-9	YVECTOR	LOW ADDRESS FOLLOWED BY HIGH

Figure 3 Vector Bin List Entry

6. RECTANGULAR BIN LIST

A Rectangular Bin List contains entries reference an address list. The address list does not contain a header. Each address in the address list contains the upper left pixel of a rectangle. The IP instruction adds all pixels in the rectangle together then scales the result, i.e. each address in the address list produces one number which is scaled using the shift count. Each list entry produces NBINS results sequentially stored at the instruction's destination address. See the section on IP instructions for further processing details. Figure 4 shows a Rectangular Bin List entry.

WOR	CONTENTS	DESCRIPTION
0	NBINS	NUMBER OF ADDRESSES IN THE ADDRESS LIST
1	NX	NUMBER OF ROWS
2	NY	NUMBER OF COLUMNS
3	SHIFT	SHIFT COUNT FOR SCALING
4-5	ADDRESS LIST	LOW ADDRESS FOLLOWED BY HIGH

Figure 4 Rectangular Bin List Entry

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7. BIT MAP BIN LIST

A Bit Map Bin List contains entries reference an address list and a processing list. The address and processing list do not contain a header. Each address in the address list contains the upper left pixel of a rectangle. The processing list contains a number of skip/take pairs. Each element in the pair is a byte, with the skip part in the upper byte of each word in the list. The IP processing involves skipping pixels indicated by skip and adding pixels indicated by take to a running total. For example, a processing list containing 3,10,12,9,13,8 results in the total of pixels 3-12, 25-33, and 46-53. The result is scaled using the shift count. Note that the skip/take pairs are based on the extracted rectangular area rather than on the source image. The number of pixels summed together at each address is the sum of the takes in the processing list. Each list entry produces NBINS results sequentially stored at the instruction's destination address. See the section on IP instructions for further processing details. Figure 5 shows a Bit Map Bin List entry.

WOR	CONTENTS	DESCRIPTION
0	NBINS	NUMBER OF ADDRESSES IN THE ADDRESS LIST
1	NPROC	NUMBER OF ENTRIES IN PROCESSING LIST
2	NX	NUMBER OF ROWS
3	NY	NUMBER OF COLUMNS
4	SHIFT	SHIFT COUNT FOR SCALING
5-6	ADDRESS LIST	LOW ADDRESS FOLLOWED BY HIGH
7-8	PROCESSING LIST	LOW ADDRESS FOLLOWED BY HIGH

Figure 5 Bit Map Bin List Entry

8. WEIGHTED BIN LIST

A Weighted Bin List contains entries that reference an address list and a weight list. Address and weight lists do not contain headers. Each address in the address list refers to the upper left pixel of a rectangle. Pixel addresses in the address list are low address word first. The IP instruction multiplies each pixel in the rectangle by the equivalently positioned weight and adds the result to a running total. Each address the in address list produces one number which is scaled using and the shift count. Each Vector list entry produces NBINS results sequentially storage at the instruction's destination address. See the section on IP instructions for further processing details. Figure 6 shows a Weighted Bin List entry. (This type of list is similar to a Vector Bin List except that the weight table is explicitly defined rather than computed from a pair of weight vectors).

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WORD	CONTENTS	DESCRIPTION
0	NBINS	NUMBER OF ADDRESSES IN THE ADDRESS LIST
1	NX	SIZE OF THE XVECTOR
2	NY	SIZE OF THE YVECTOR
3	SHIFT	SHIFT COUNT FOR SCALING
4-5	ADDRESS LIST	LOW ADDRESS FOLLOWED BY HIGH
6-7	WEIGHT LIST	LOW ADDRESS FOLLOWED BY HIGH

Figure 6 Vector Bin List Entry

9. IP INSTRUCTIONS

10. DEP SUPPORT CAPABILITIES

10.1. General Capability

The DEP can load data of any type into IP main memory. There are 3 ways in which the DEP can load IP memory. These are data (uncorrected), list (8 byte correction codes), and tables (2 byte lookup tables). In general, data memory is used for temporary storage, table memory is used for lookup tables that are accessed randomly, and list memory is used for processing instructions that are read sequential. For example, camera images go to data memory, reciprocal tables go to table memory, and full disk cropping instructions go to list memory. While the DEP can load data of any of these types, table and list loads are most common. (The DEP can also load the IP writeable control store; however, that capability is not covered in this document).

The DEP can load tables and lists to IP memory by three different methods: computation, decompression, or direct. In all cases a load command includes table identifier, a version number, and a target address in the IP. Additional parameters depend on the specific table or list.

Computed lists and tables are loaded by sending the DEP a telecommand with a set of parameters that are used for the computation. Computed tables are reciprocals, and square roots. Computed lists are full disk crop, limb figures, baseline 2D vector, and baseline rectangles.

Compressed tables are either built-in or uplinked. Built-in tables are loaded to the IP by sending the DEP only a table load telecommand. Uplinked tables are first loaded to DEP RAM. Then the table is decompressed and loaded to the IP by a telecommand(s) specifying, among other things, the address in RAM of the (recently) loaded compressed table.. Velocity lookup tables are the only compressed tables.

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All other lists and tables are loaded directly. Direct loading requires a table or list first be loaded to DEP RAM exactly as it will be used in the IP. The table of list is then loaded to the IP by a telecommand specifying the table or list identifier and the table's RAM address.

The DEP capability includes a map of IP table and lists. The DEP reports one IP load map per observing cycle (nominally one minute). The report appears in housekeeping telemetry. A report consists of a table identifier, it's address in IP memory, and its version number. Up to 33 tables and lists are reported; so, a complete map occurs every 33 minutes.

10.2. Telecommands

10.2.1. Telecommand Summary

A single (database) mnemonic, *mbiptbl*, is used for all table and list load commands. The first parameter is a table identifier. The identifier contains 2 components: a type and a number. The legal values for number vary with type. Number is associated with the DEP produce table/list map (See parameter 10.3). Except for load geometry, identifier is always followed by (IP) destination address (2 words) and version number. Additional parameters vary with type. Table 7 summarizes table load commands. Additional details appear in the parameters that follow. For all commands except load geometry, the parameters column of table 7 shows parameters after version number. For load geometry, parameters begin after identifier.

NUMBER	TYPE	DESCRIPTION	PARAMETERS
0-3	0	Reciprocal	Numerator
0-3	1	Square Root	Scale Factor
0-3	2	Velocity	Optional (DEP) Source Address (2 words)
0	3	Full Disk Crop	NONE
0	4	Maximum Annulus	None
0	5	Limb Figure	Outer Radius; Inner Radius
0	6	Baseline Vector	Max Raidius, Spacing, Vector Size (VS) VS Vector Components
0	7	Baseline Rectangles	Max Radius; Spacing; Width; Height
0-7	8	Generic Lookup	(DEP) Source Address (2 words); Code; Length
0-7	9	Generic List with Header	(DEP) Source Address (2 Words); Code; List Length; Load Length
0-7	A	Generic List Without Header	(DEP) Source Address (2 Words); Load Length
0	B	Generic Data	DEP Source Address (2 words), Length
0	10	Geometry	Maximum Radius; Minimum Radius; Suncen X; Suncenter Y; Row Length

Table 7 Table and List Load Telecommand Summary